Public Affairs 854
Macroeconomic Policy and International Financial Regulation
Lecture 9-10
2/22-24/2021

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Outline

- Motivation for IS-LM
- Real Side
- Financial Side
- Equilibrium
- Policy
- Limitations to Monetary Policy

Motivation for IS-LM

Bringing In the Financial Side

- In the Keynesian Cross, only real variables mattered.
- There is no role for money, bonds, interest rates
- Investment depends only on “animal spirits”, i.e., the optimism/pessimism of firm owners.
- We need to expand the model so that monetary policy (and the Fed) matters

Opening Up to Cross-border Capital Flows

- After developing a model with both real and financial sides, the cross-border capital flows are added
- This allows for interactions betweencapital flows, interest rates and exchange rates
- Or, capital flows and domestic money supply

The Real Side

System of Equations

(13.2) $Y = AD$ — Equilibrium condition

(13.1) $AD \equiv C + I + G + \underbrace{X - IM}_{\substack{\text{trade balance} \\ \text{or} \\ \text{net exports}}}$ — Def'n aggregate demand

(13.3) $C = \underbrace{\bar{C}}_{\substack{\text{autonomous} \\ \text{consumption}}} + c(Y - \bar{T})$ — Consumption function (and def'n disposable income)

$I = \bar{I}$, $G = \bar{G}$, $X = \bar{X}$ — Autonomous spending for investment, gov't, export spending

(13.4) $IM = \underbrace{\overline{IM}}_{\substack{\text{autonomous} \\ \text{imports}}} + mY$ — Import function

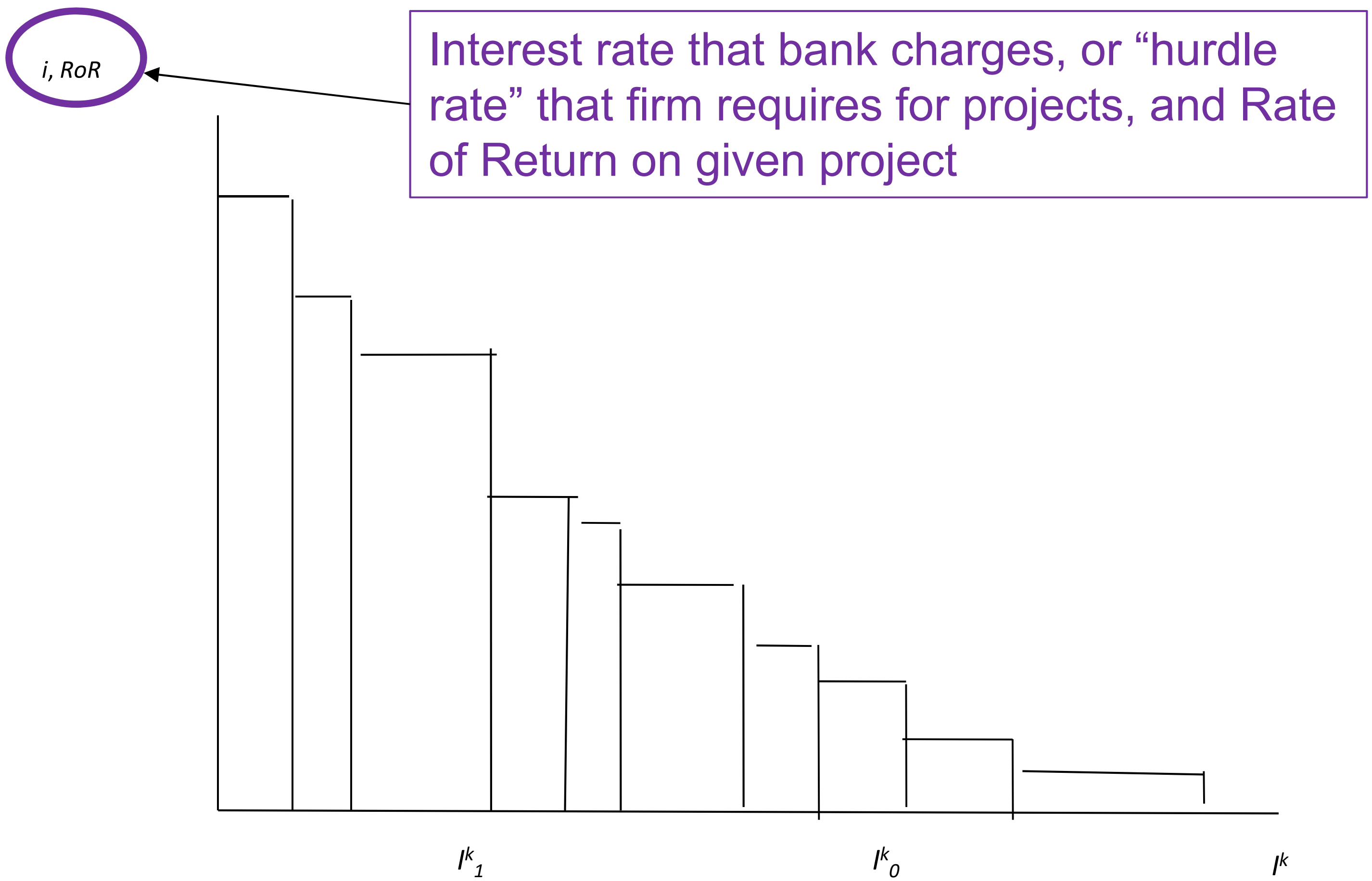
Modifying the Keynesian Cross

(13.2) $Y = AD$	Equilibrium condition
(13.1) $AD \equiv C + I + G + \underbrace{X - IM}_{\substack{\text{trade balance} \\ \text{or} \\ \text{net exports}}}$	Def'n aggregate demand
(13.3) $C = \underbrace{\bar{C}}_{\substack{\text{autonomous} \\ \text{consumption}}} + c(Y - \bar{T})$	Consumption function
(14.1) $I = \bar{I} - bi$	Investment function
$G = \bar{G}, X = \bar{X}$	Gov't, export spending
(13.4) $IM = \underbrace{\overline{IM}}_{\substack{\text{autonomous} \\ \text{imports}}} + mY$	Import function

Interest Sensitivity of Investment

- Investment is spending on plant & equipment (not purchasing a stock or bond)
- Look at the decision from the perspective of a firm owner, who has to decide which investment projects to undertake
- Rank the projects from highest rate of return to lowest

Interest Sensitivity of Investment



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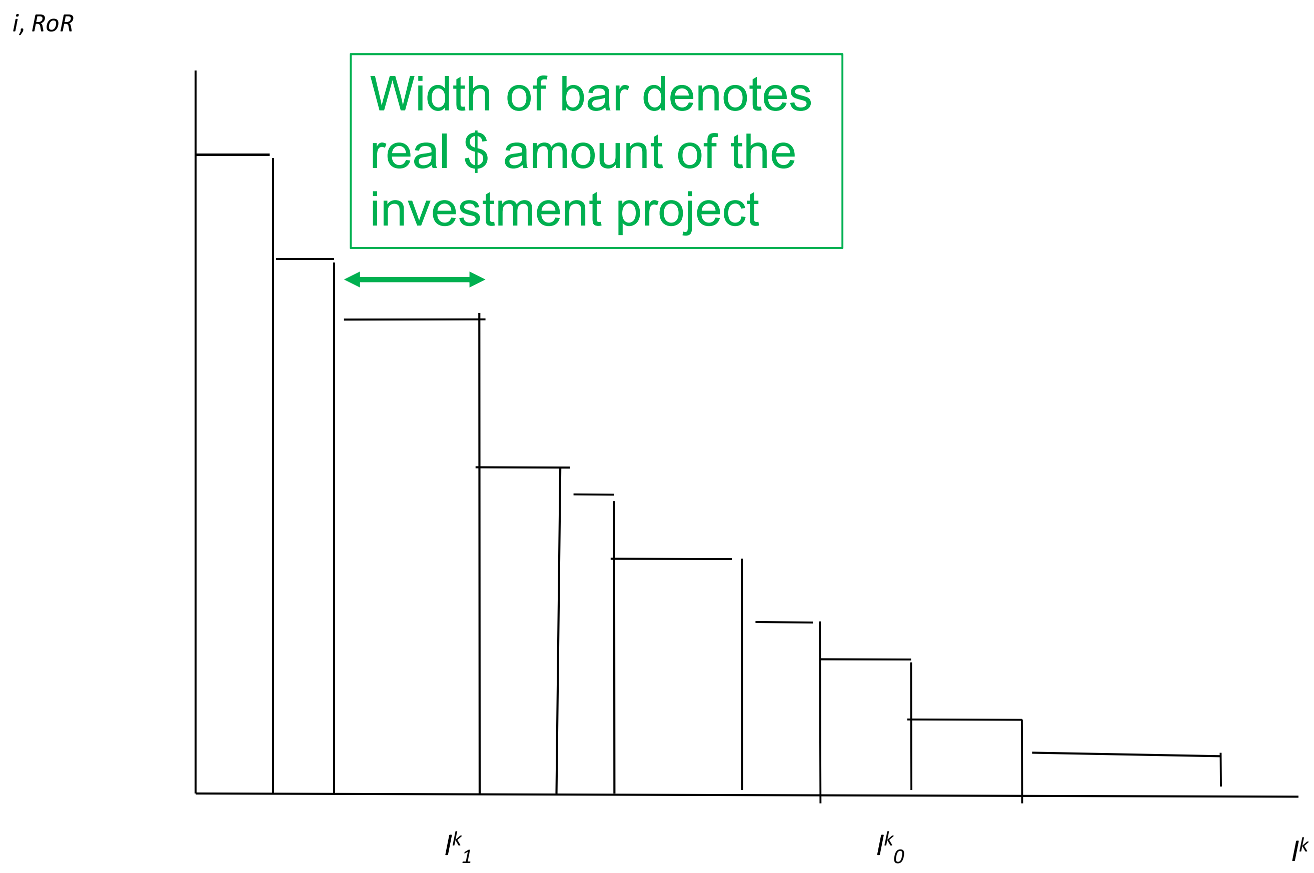

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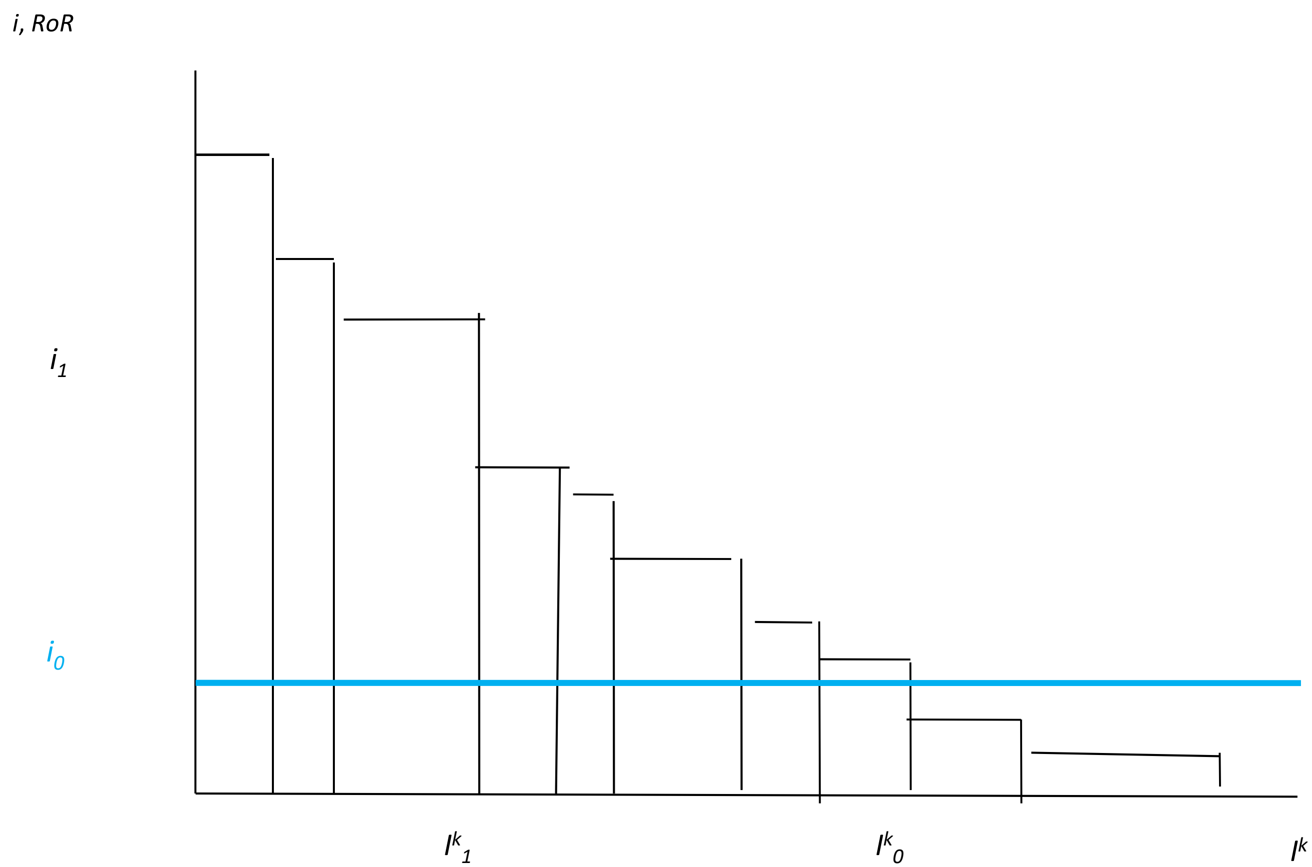

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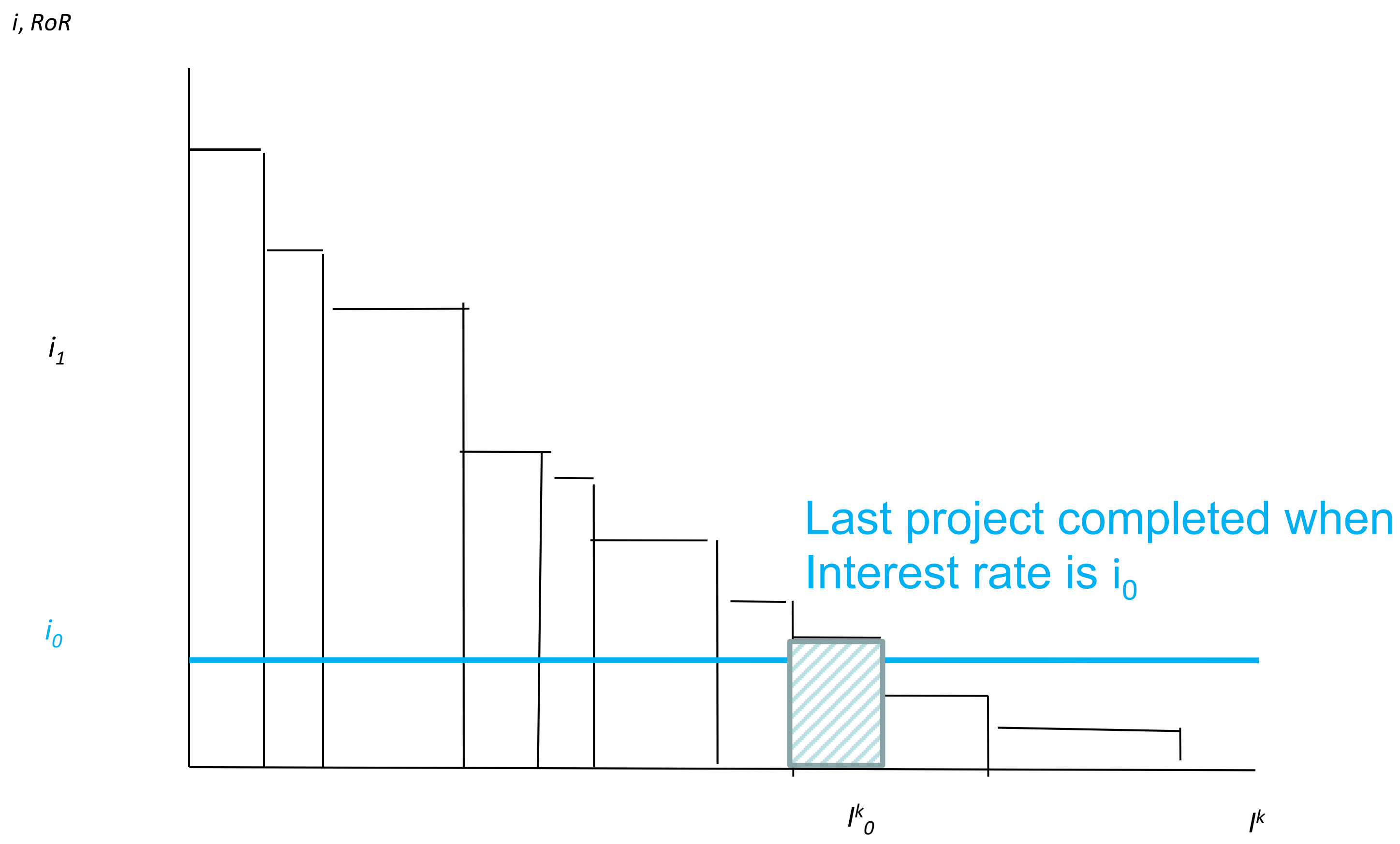

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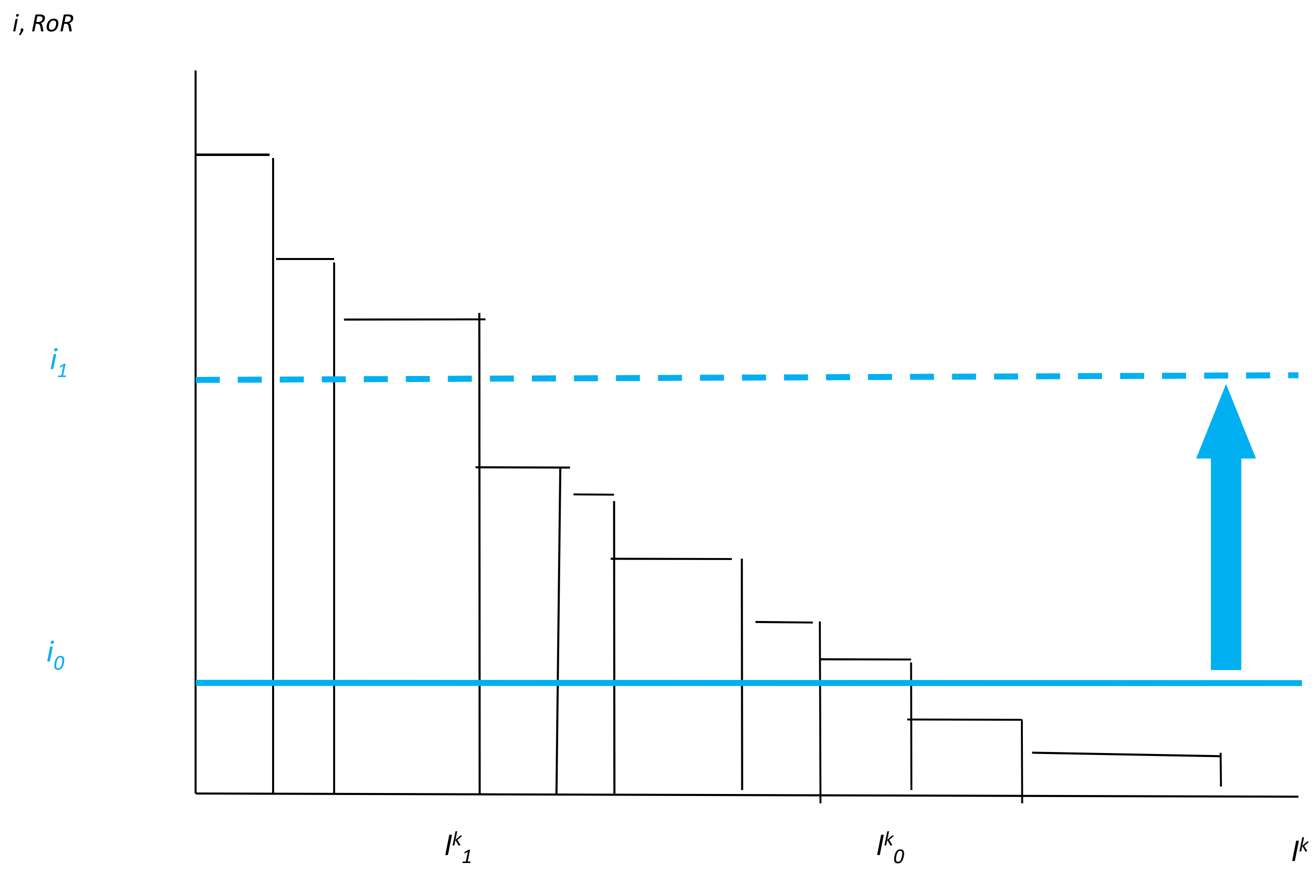

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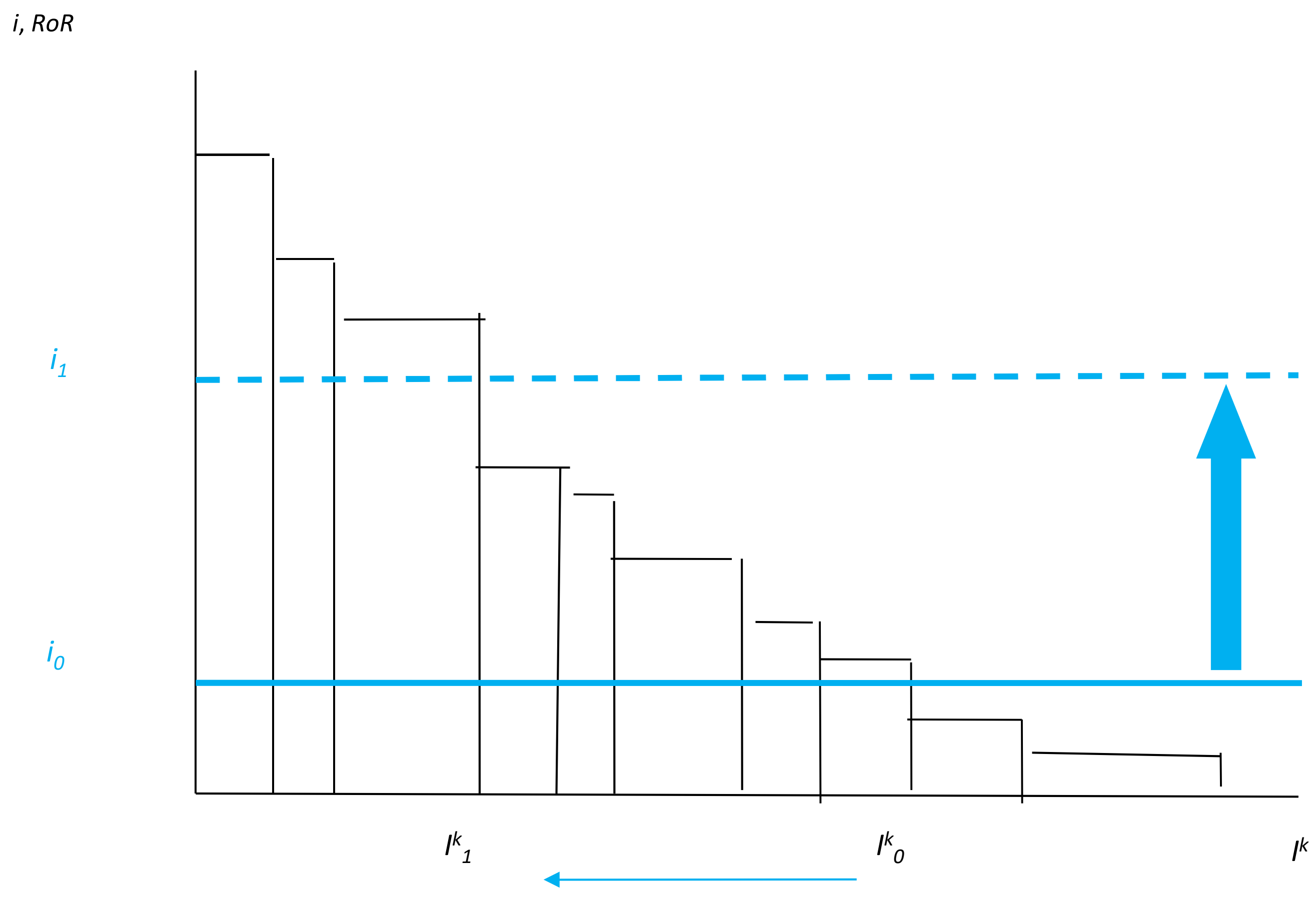

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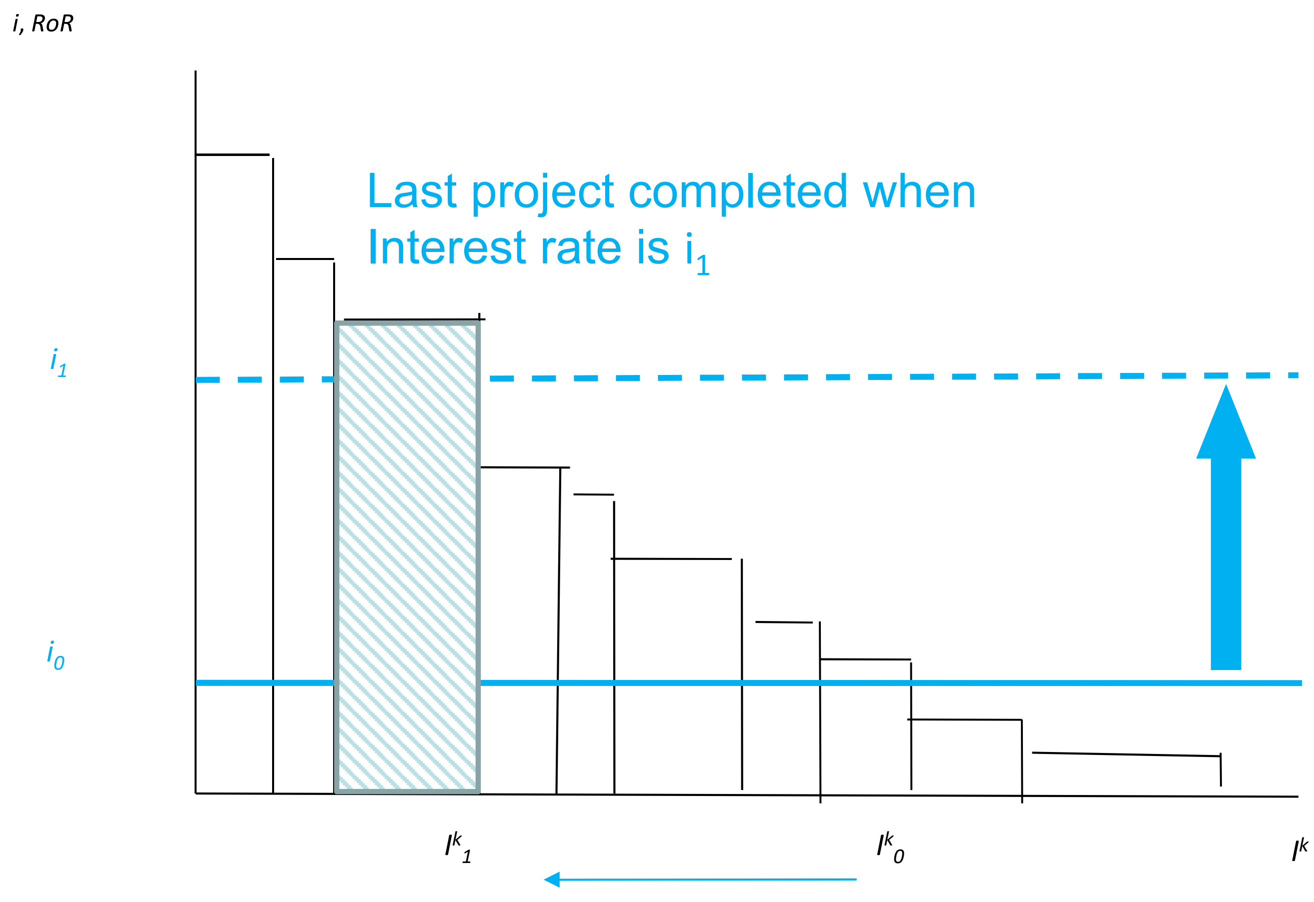

Solving the System

- Use equilibrium condition and definition of aggregate demand:

(13.5a) $$\underbrace{Y = AD}_{\substack{equilibrium \\ condition}} \equiv \underbrace{C}_{consumption} + \underbrace{I}_{investment} + \underset{government}{G} + \underset{exports}{X} - \underbrace{IM}_{imports}$$

- Substitute equations for each variable:

(13.5) $$\underbrace{Y = AD}_{\substack{equilibrium \\ condition}} \equiv \underbrace{\bar{C} + c(Y - \bar{T})}_{consumption} + \underbrace{\bar{I} - bi}_{investment} + \underbrace{\bar{G}}_{government} + \underbrace{\bar{X}}_{exports} - \underbrace{(\overline{IM} + mY)}_{imports}$$

Solving for Y

$$Y - (c-m)Y = Y\big(1-(c-m)\big) = (\bar{C} - c\bar{T} + \bar{I} + \bar{G} + \bar{X} - \overline{IM}) - bi$$

(14.2) $$Y = \bar{\alpha}[\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q} - bi]$$

- Since i can take on different values, then Y can take on different values even if autonomous spending and real exchange are held constant (no “0” subscript)
- I.e., this is an equation of a *line*

(14.2a) $$i = \frac{[\bar{A}+\bar{X}-\overline{IM}+(n+v)\bar{q}]}{b} - \frac{(1-c+m)}{b}Y$$

The Financial Side

The Financial Side

- Up to now, the stock market, interest rates, banks, money supply, bonds all don’t enter
- Obviously, those are important factors.
- How to add in the financial side in a tractable fashion?

The Financial Side

- Consider “assets”, claims to future returns.
- Stocks (equities), bonds, real estate, physical capital (machines, buildings), money
- To simplify, consider only “money” and “bonds”.
  - Bonds: anything that yields a return
  - Money: anything 0 return, useful for transactions

The Financial Side

- Consider only “outside assets”, assets that are asset to someone in the private sector, but not a liability to anyone in the private sector
  - Excludes a share of Apple, bond issued by United
  - Includes currency, bond issued by US government
- Consider currency “money”. Then the only assets are Money and (Govt) Bonds

System of Equations

(14.3) $$\frac{M^d}{P} = \frac{M^s}{P}$$ Equilibrium condition

(14.4) $$\frac{M^s}{P} = \frac{\bar{M}}{\bar{P}}$$ Money supply (exogenous, set by central bank)

(14.5) $$\frac{M^d}{P} = kY - hi$$ Money Demand

Money Demand

- Money is useful for transactions, but has zero return
- k is sensitivity of real money demand to income (transactions assumed to rise with income), $\partial(M^d/P)/\partial Y$
- $-h$ is the sensitivity of real money demand to interest rate (opportunity cost of holding 0 interest bearing money rises with interest rate), $\partial(M^d/P)/\partial i$

Solving for LM

- Substitute money supply, money demand into equilibrium condition

$$\frac{\bar{M}}{P} = \frac{M^s}{P} = \frac{M^d}{P} = kY - hi$$

- Solve for the interest rate

$$(14.6) \qquad i = -\left(\frac{1}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) + \left(\frac{k}{h}\right)Y$$

- Note that this is no “0” subscript, so this is an equation of a line

Interpretation of LM

- This is the combination of interest rates and income levels such that money demand equals (a constant, given) money supply
- Since there are only two assets (money and bonds), when money market is in equilibrium, the bond market is in equilibrium

Equilibrium

Solving for Equilibrium

- We have two equations (IS, LM)
- And two unknowns (*i*, *Y*)
- Solve as in algebra problem

(14.2) $$Y = \bar{\alpha}[\bar{A} + \bar{X} - \overline{IM} + (n + v)\bar{q} - bi]$$ <*IS* curve>

(14.6) $$i = -\left(\frac{1}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) + \left(\frac{k}{h}\right)Y$$ <*LM* curve>

Solving for Equilibrium

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(14.6) $$i = -\left(\frac{1}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) + \left(\frac{k}{h}\right)Y$$ <*LM* curve>

(14.2a) $$Y = \bar{\alpha}[\bar{A} + \bar{X} - \overline{IM} + (n + v)\bar{q} - b\left(-\left(\frac{1}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) + \left(\frac{k}{h}\right)Y\right)]$$

(14.2b) $$Y(1 - c + m) = [\bar{A} + \bar{X} - \overline{IM} + (n + v)\bar{q} + \left(\frac{b}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) - \left(\frac{bk}{h}\right)Y]$$

Solving for Equilibrium

(14.2) $$Y = \bar{\alpha}[\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q} - bi]$$ <*IS* curve>

(14.6) $$i = -\left(\frac{1}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) + \left(\frac{k}{h}\right)Y$$ <*LM* curve>

(14.2a) $$Y = \bar{\alpha}\left[\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q} - b\left(-\left(\frac{1}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) + \left(\frac{k}{h}\right)Y\right)\right]$$

(14.2b) $$Y(1-c+m) = \left[\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q} + \left(\frac{b}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) - \left(\frac{bk}{h}\right)Y\right]$$

- Bring Y terms to LHS, solve:

(14.7) $$Y_0 = \underbrace{\left(\frac{1}{1-c+m+\frac{bk}{h}}\right)}_{\equiv\hat{\alpha}}\left[\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q} + \left(\frac{b}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right)\right]$$

Equilibrium Income

- IS equation defines the set of i,Y combinations where real side of the economy is in equilibrium (Y=AD)
- LM equation defines the set of i,Y combinations where financial side of the economy is in equilibrium ($\frac{M^d}{P} = \frac{M^s}{P}$)
- Solution to IS, LM is the only combination of i,Y in which both markets are in equilibrium

Equilibrium Interest Rate?

- Substitute IS into LM curve and solve for *i*

$$i = -\left(\frac{1}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) + \left(\frac{k}{h}\right)Y \qquad (14.6)$$

<*LM* curve>

$$Y = \bar{\alpha}[\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q} - bi] \qquad (14.2)$$

<*IS* curve>

- Or, substitute equilibrium *Y* into LM curve

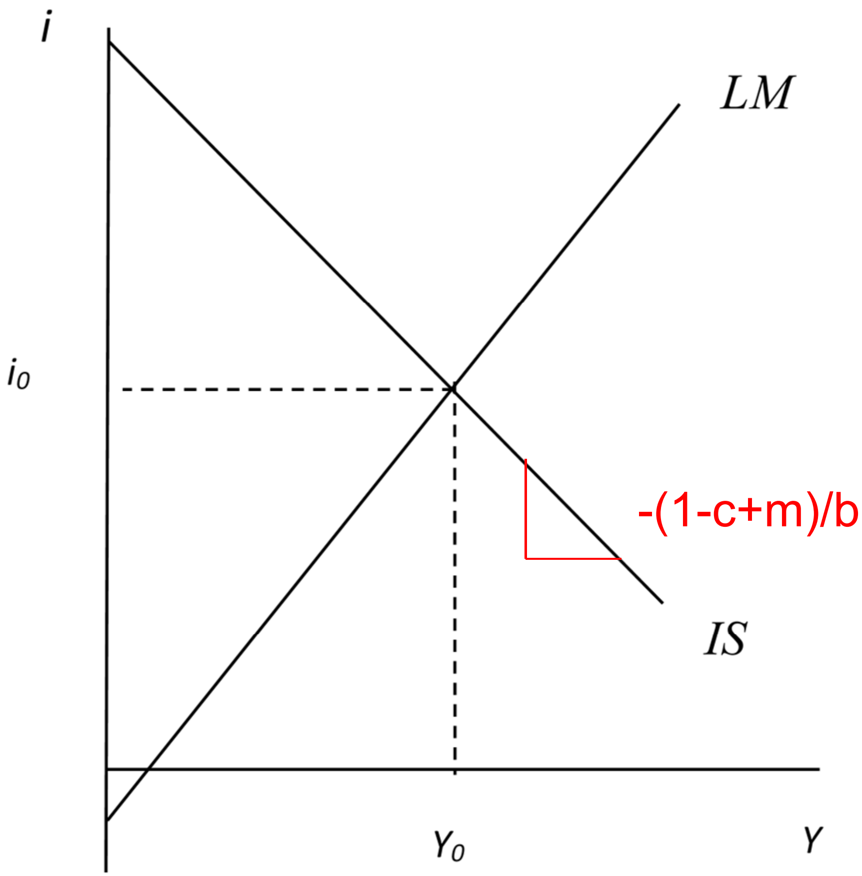
$$i = -\left(\frac{1}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right) + \left(\frac{k}{h}\right)Y \qquad (14.6)$$

No need to solve

<*LM* curve>

$$Y_0 = \underbrace{\left(\frac{1}{1-c+m+\frac{bk}{h}}\right)}_{\equiv\hat{\alpha}}[\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q} + \left(\frac{b}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right)] \qquad (14.7)$$

Graphical Interpretation



$$i = \frac{[\bar{A}+\bar{X}-\overline{IM}+(n+v)\bar{q}]}{b} - \frac{(1-c+m)}{b}Y$$

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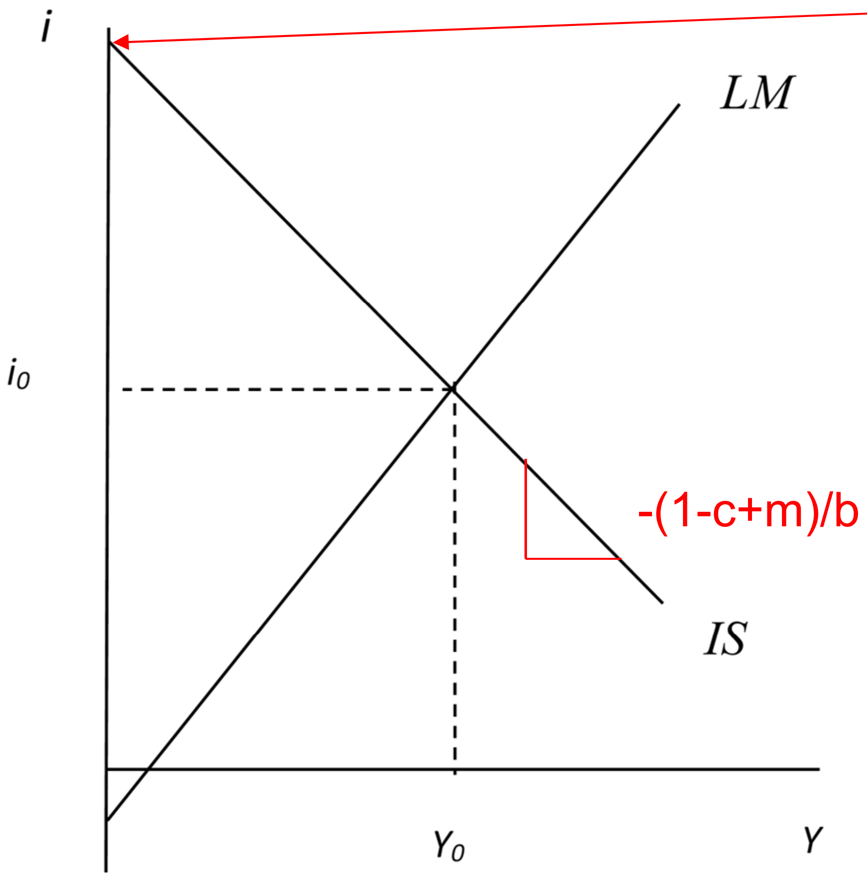

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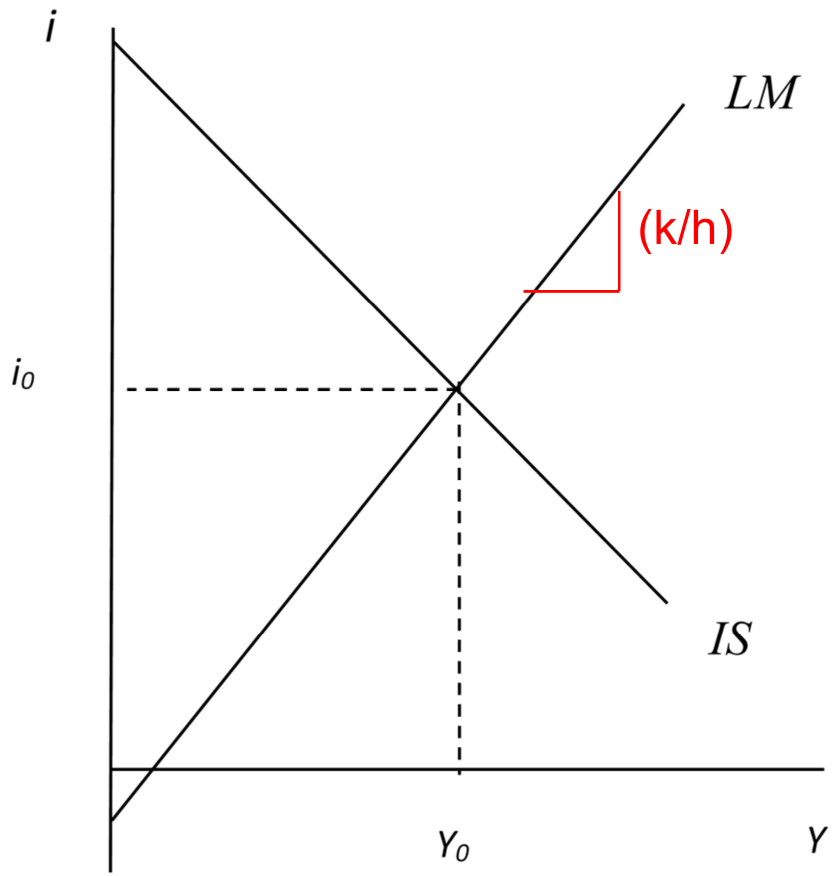

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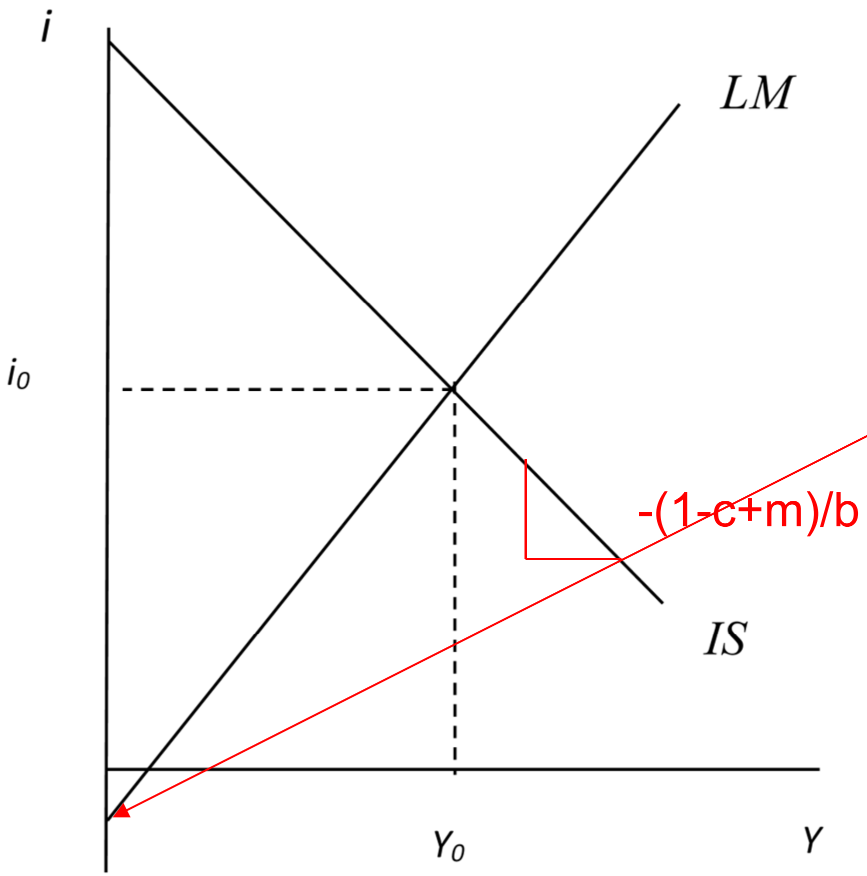
(14.7) $$Y_0 = \underbrace{\left(\frac{1}{1-c+m+\frac{bk}{h}}\right)}_{\equiv \hat{\alpha}} [\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q} + \left(\frac{b}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right)]$$

Graphical Interpretation



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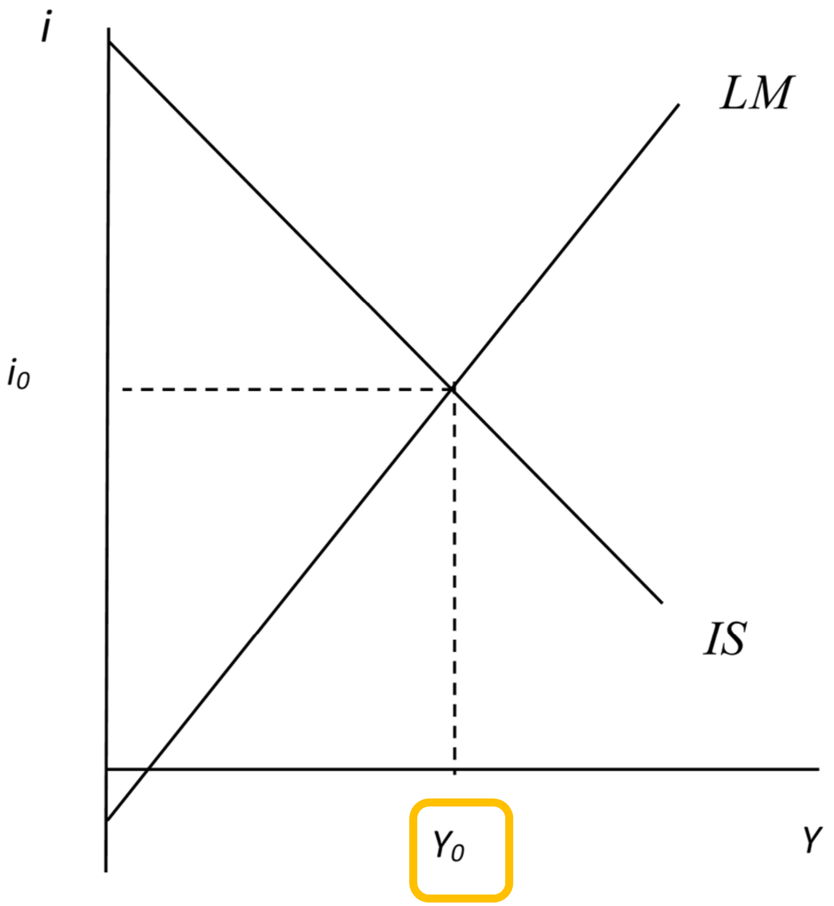

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Policy

Algebraic Formulation

(14.7) $$Y_0 = \underbrace{\left(\frac{1}{1-c+m+\frac{bk}{h}}\right)}_{\equiv\hat{\alpha}}[\bar{A} + \bar{X} - \overline{IM} + (n+v)\bar{q} + \left(\frac{b}{h}\right)\left(\frac{\bar{M}}{\bar{P}}\right)]$$

(14.8) $$\Delta Y = \hat{\alpha}[\Delta A + \Delta X - \Delta IM + (n+v)\Delta q + \left(\frac{b}{h}\right)\Delta\left(\frac{M}{P}\right)]$$

For multipliers, hold all else constant, sequentially

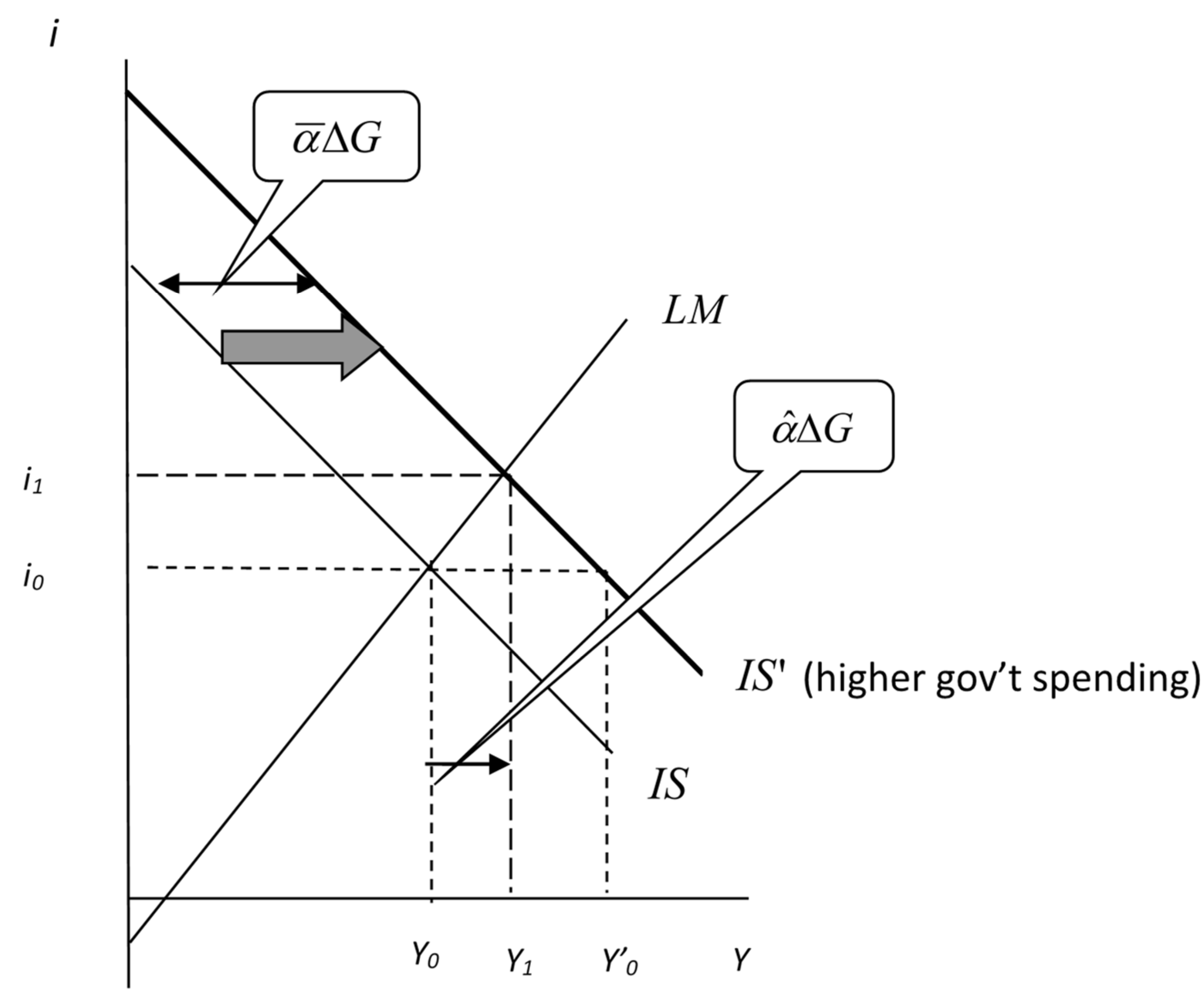
$$\frac{\Delta Y}{\Delta G} = \hat{\alpha} \geq 0$$

$$\frac{\Delta Y}{\Delta q} = \hat{\alpha}(n+v) \geq 0$$

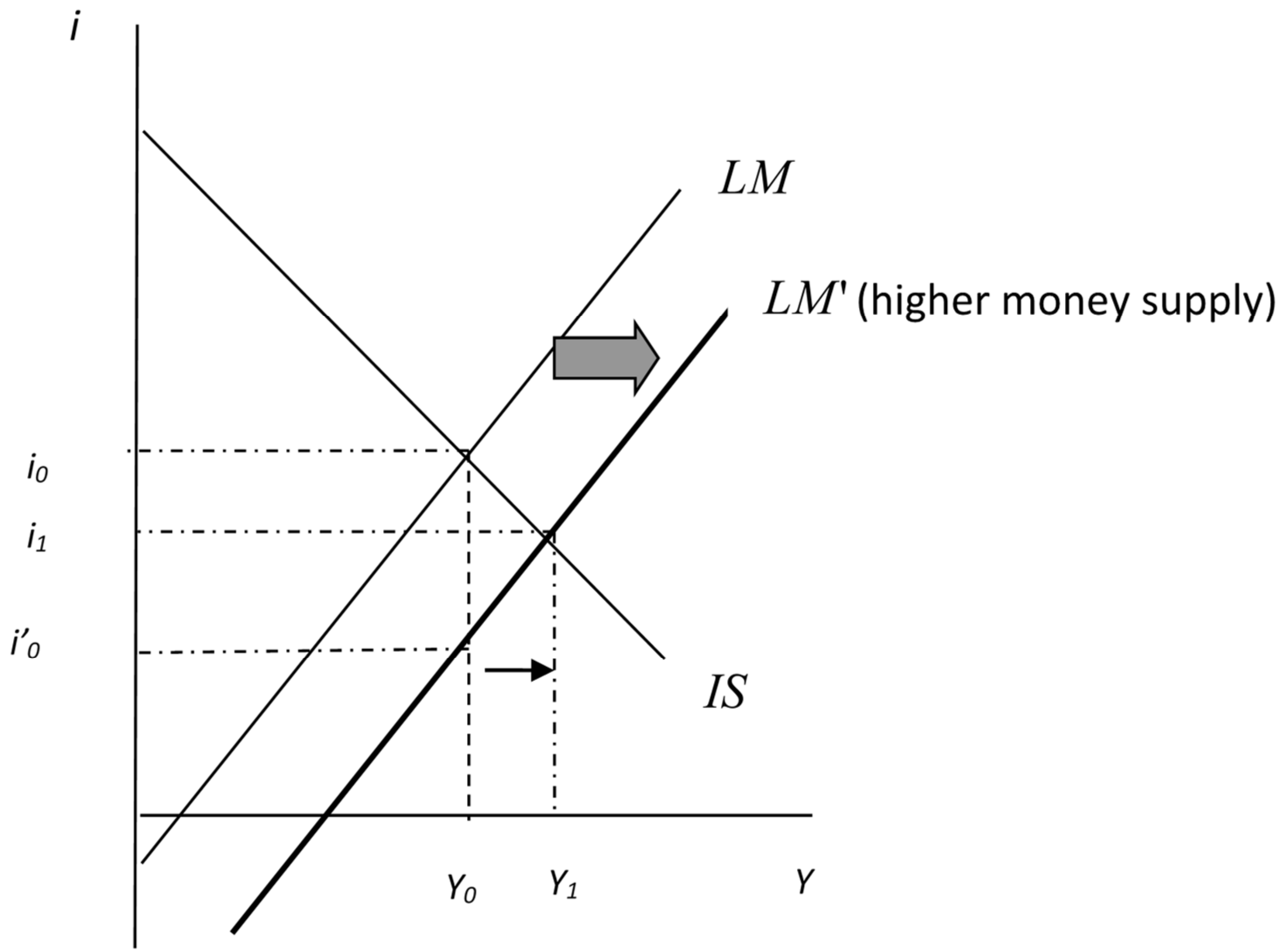
$$\frac{\Delta Y}{\Delta(M/P)} = \hat{\alpha}\left(\frac{b}{h}\right) \geq 0$$

$$\frac{\Delta Y}{\Delta t} =? < 0$$

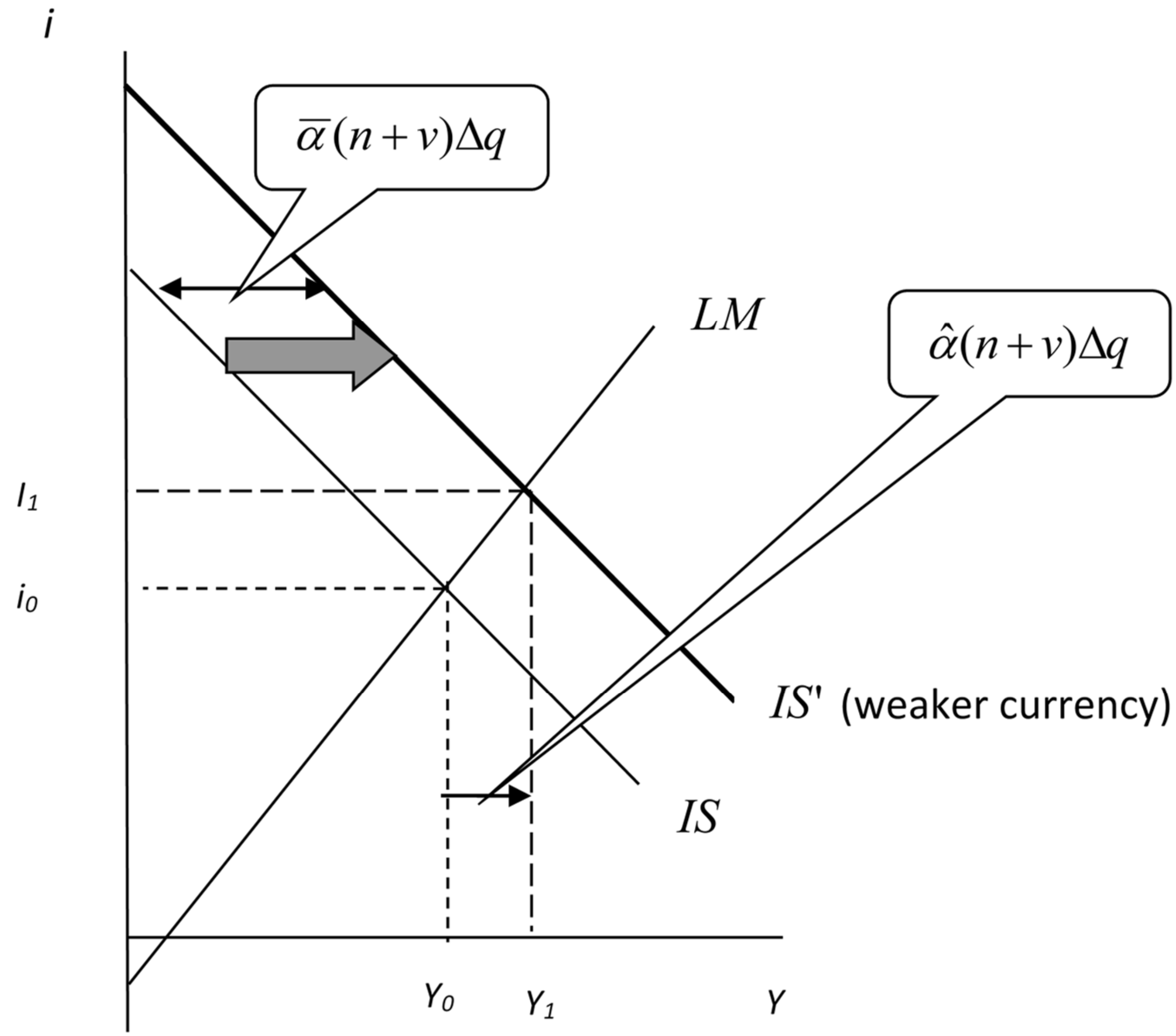
Graphical: Fiscal (Gov't Spending)



Graphical: Monetary



Graphical: Exchange Rate



Limitations to Monetary Policy

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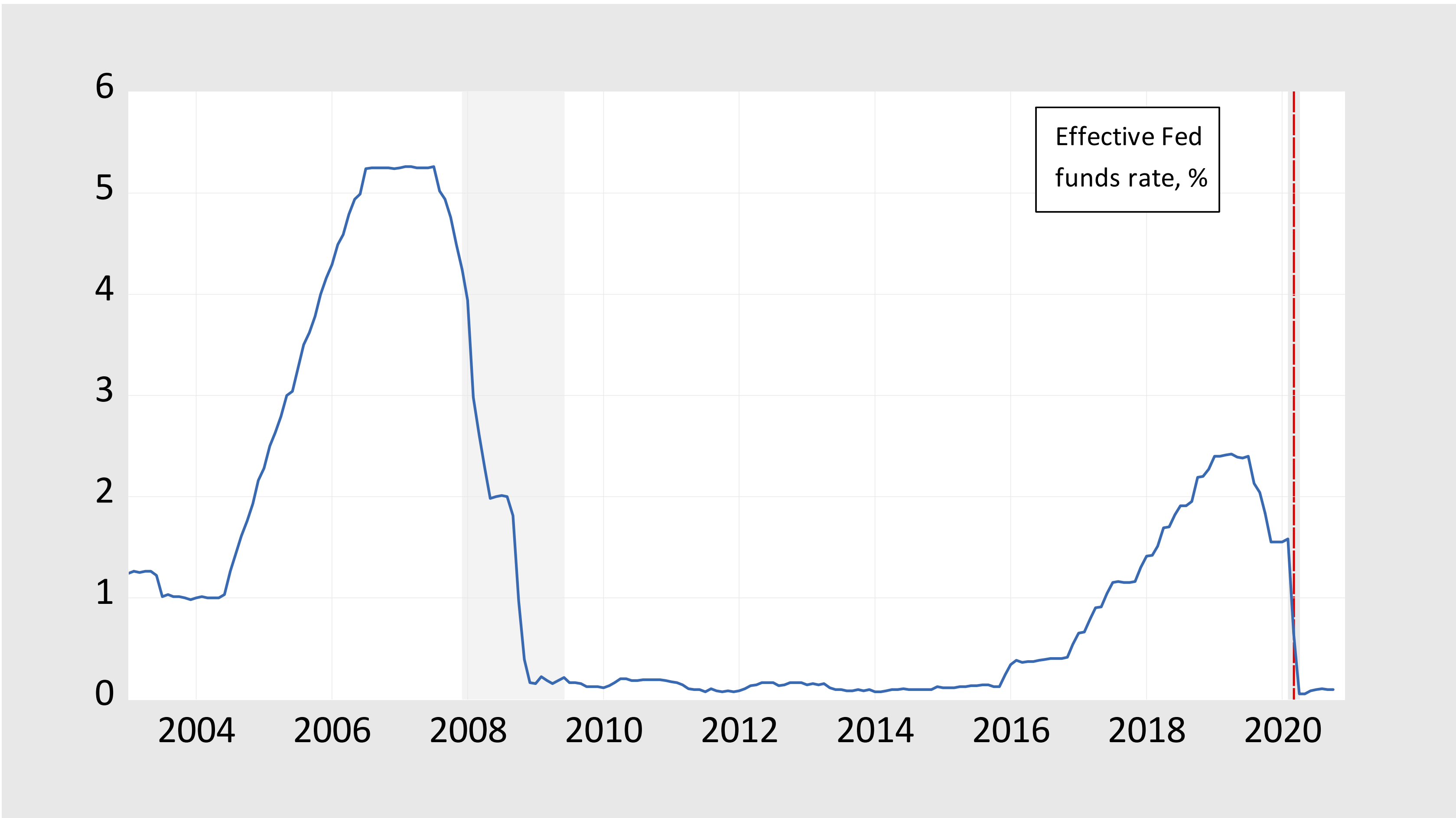
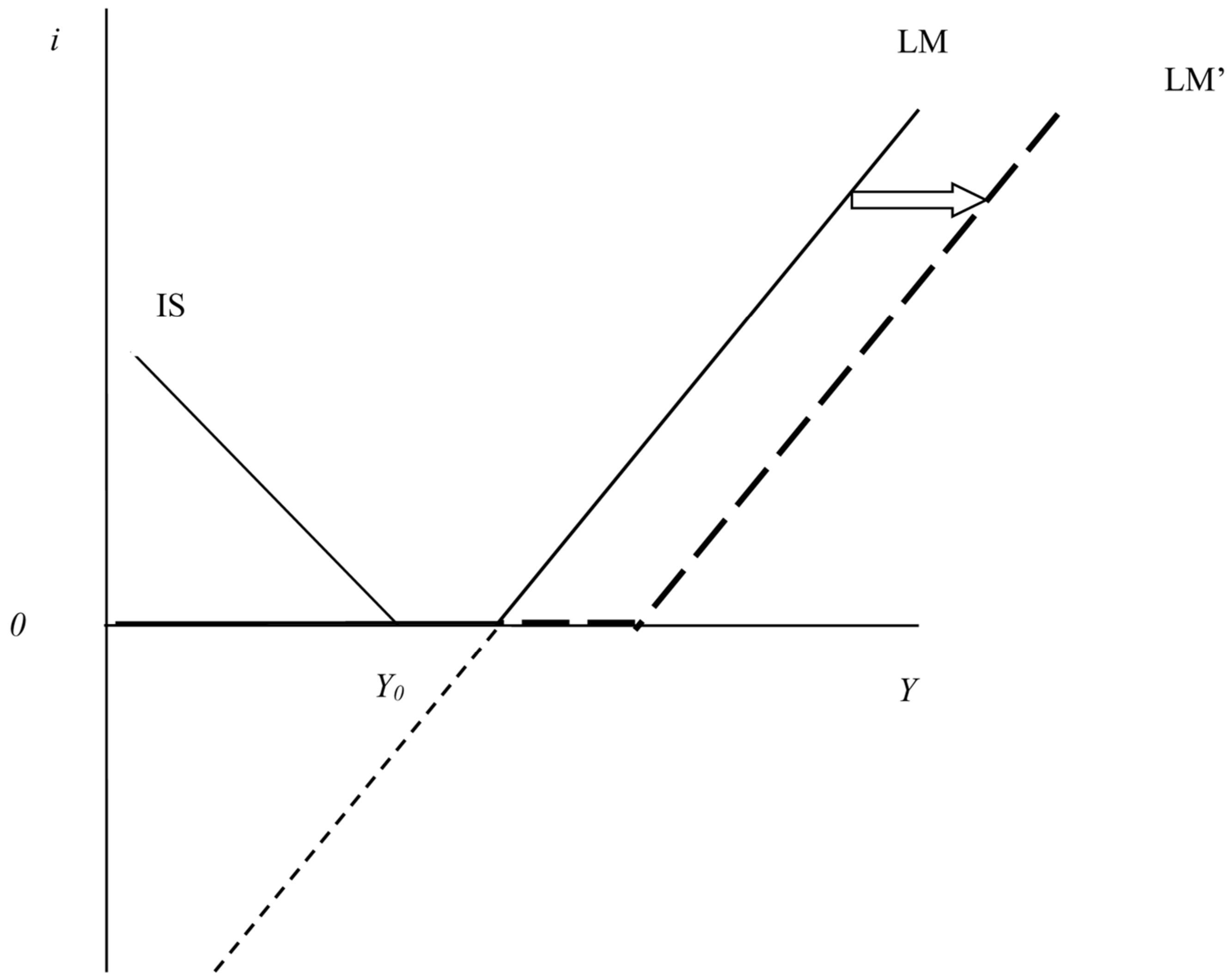


Limitations to Monetary Policy



Next Lecture

- Recap
- Detail on monetary policy
- When does fiscal policy not work?
- When does monetary policy not work?